

City of Corvallis

Salmon Response Plan

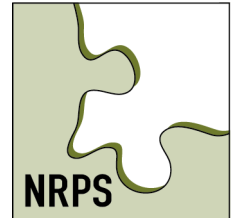
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Appendix 2

**Impact Evaluation Methodology Technical Memorandum
Shapiro and Associates, Inc.
April 18, 2001**



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TECHNICAL MEMORANDUM

DATE: APRIL 18, 2001
TO: GREG GESCHER
FROM: ROB DILLINGER
PROJECT NAME: CITY OF CORVALLIS ESA 4(D) RESPONSE PLAN
PROJECT NUMBER: 2005033
RE: IMPACT EVALUATION METHODOLOGY

OVERVIEW

The ESA final 4(d) Rules released in the federal register July 10, 2000 - pose challenges to cities such as Corvallis. The following is a brief discussion of the challenges and risks the final Rules may present to the City, and the proposed methodology to identify, evaluate, and quantify the impacts on chinook salmon habitat from Corvallis city government and private citizen activities and behaviors. This understanding is based on our team's extensive experience working with NMFS, our knowledge of the 4(d) Rule, and our experience with local jurisdictions in both Oregon and Washington (Puget Sound Tri-County region).

Under the 4(d) Rules, Corvallis will be required to develop a program that will protect the listed species of chinook in the upper Willamette Basin. The Rules could have far-reaching implications for City activities, including design, operation, and maintenance of public works; land use; parks and recreation; private development; and public development activities.

Section 9 of the ESA prohibits taking listed species. The term "take" is broadly defined to include any activity that harms or kills listed species. NMFS recently defined the term "harm" to include significant habitat modification or degradation that actually kills or injures listed species by significantly impairing essential behavioral patterns. These essential behavioral patterns may include spawning, rearing, and migration.

Section 4(d) of the ESA provides that NMFS may adopt regulations it deems necessary for the conservation of threatened species. The current NMFS 4(d) Rules identify activities the Agency believes may constitute a "take" of listed species. The Rules also identify activities that "conserve" listed species; that is, activities conducted pursuant to NMFS-approved land use

regulations. The Rules identify 13 activities or programs that NMFS believes will limit impacts on salmonid species, so added protection through application of ESA Section 9 will be unnecessary.

NMFS intends to use the 4(d) Rule process as a way to encourage governments to review their regulations and make changes to ensure activities conducted pursuant to such regulations do not cause a “take.” Furthermore, NMFS is actively encouraging and is “interested in working with local jurisdictions to develop programs that protect endangered and threatened species and their habitats and to recognize such programs through 4(d) Rules exceptions or other mechanisms.” (*ESA and Local Governments: Information on 4(d) Rules*, NMFS).

After “take” prohibitions become final, all parties, including states, local governments, and private citizens and corporations must avoid taking threatened species or risk civil and criminal sanctions. Recent federal court cases suggest that states and local governments may be liable for actions they authorize or permit, if such actions result in a “take.” While the federal government may bring civil or criminal enforcement for ESA violations, the ESA also permits any person to initiate a citizen suit to enjoin violations of the Act. Such provisions will likely lead to greater scrutiny of proposed development actions by environmental and citizen groups.

The issuing of the final 4(d) Rules by NMFS initiated a variety of environmental planning processes within the Puget Sound and areas in Oregon where fish are listed. The NMFS 4(d) Rules set forth an administrative process whereby governmental entities may except their land use and water quality regulations from ESA restrictions. National Marine Fisheries Service (NMFS) will evaluate MCRI practices using the following evaluation criteria:

1. Development will avoid inappropriate areas (e.g. slopes, wetlands, riparian areas)
2. Avoid stormwater discharge impacts to water quality, quantity and the watershed hydrograph
3. Provide adequately protective riparian area management to maintain properly functioning conditions and mitigate unavoidable damage
4. Avoid stream crossings by roads, utilities etc, when possible and minimize impacts where crossings are unavoidable through choice of mode, sizing, and placement
5. Protect historical stream geomorphology and avoid hardening of banks and shorelines
6. Protect wetlands and wetland functions
7. Preserve hydrologic capacity of all streams, permanent and intermittent, to pass peak flows
8. Provide for and encourage use of native vegetation for landscaping to reduce water, pesticide and herbicide use
9. Ensure water supply demands can be met without having a negative impact on flows, directly or through influences on groundwater. Any new diversions should

be placed and screened in such a way as to prevent injury to and or death of salmonids

10. Provide necessary enforcement, funding, reporting, and implementation mechanisms and formal plan evaluations at no greater than 5 year intervals
11. Comply with all other state and Federal environmental and natural resource laws
12. Provide the NMFS with annual reports regarding implementation and effectiveness

Critical to the NMFS rulings on take is the concept of properly functioning conditions (PFC). The agency feels very strongly, based on information presented in the publication "An Ecosystem Approach to Salmonid Conservation", that such habitat conditions as those physical and biological parameters essential for the conservation and continued well-being of the species. These include water quality (temperature, dissolved oxygen) and quantity, habitat features such as substrate, habitat complexity, cover etc. NMFS further recognizes the dynamic nature of these features, and so has not set any specific static limits or values to attain. Rather, the focus is on processes and the maintenance of those functions at a number of scales.

Compliance with the NMFS rules governing incidental take involves the development of an integrated plan, comprising all the operations undertaken by the City of Corvallis. NMFS has stated that it will be more inclined to look at such integrated efforts first, rather than approving each individual program as it is presented to them. In order to accomplish this comprehensive approach to compliance, however, there needs to be initial steps that begin to identify the City activities, programs, and private citizen behaviors that may cause harm to listed fish habitat. This project provides that initial assessment. It will assist the City in determining where it should begin to invest its resources to comply with ESA 4(d) Rules.

The following is the initial interpretation of how we (Shapiro and Associates, Inc. [SHAPIRO] and its subconsultants) will evaluate potential impacts on fish and fish habitat for the City of Corvallis. The first step is to assess the baseline fish habitat information and the effect of current activities on this habitat. This is accomplished in Phase One of the program, where we also determine the level of human impact on the salmon habitat (i.e., program/activity/service provided by the City and private citizen/business behavior).

Generally, the approach requires a consistent methodology that all team members can use to prepare the impact information. Each team member will have the necessary information/directions and will not require continual supervision from the Project or Aquatic Task Managers. To accomplish this goal, however, it is important to set up the methodology so all team members understand exactly what they need to do.

CATEGORIES AND DATA ELEMENT NEEDS

The following sections list the protocols and procedures that staff will be using to collect data and evaluate programs and policies. Again, the purpose is to focus on which current practices have an impact on fish habitat, and for those that do have an impact, to determine the degree of impact.

Assessment Methodology

Categories for data collection/evaluation

The following will be the evaluation categories (data elements, activities/programs) for each stream reach and the party responsible for conducting the analysis:

- Stream and riparian habitat baseline conditions, potential impacts and pathways
- Planning and Regulatory Services(zoning, land use) and Public services (fire, police, etc.)
- City Environmental Services (water, stormwater, sewer, streets)
- Programmatic elements of Maintenance (City maintenance facilities), Parks and Recreation (parks, open space, recreation/play fields), and citizen behavior

Data requests will be made in Phase 1, Task 2 for any baseline information in the possession of the City or other agencies. These data will be analyzed in this Task, with identification of gaps to be filled by analysis carried out in Task 3.

Model Development

In order to establish linkages between habitat elements and potential impacts, some decision-making technique should be used. A conceptual model will be developed to guide all phases of the project. This approach is similar to that of Adaptive Environmental Assessment and Management (AEAM) that also uses models to establish priorities. The approaches differ in that AEAM requires a simulation mode to be built and run. This project's approach more closely resembles the Problem Formulation phase of the USEPA's Ecological Risk Assessment. In this phase, conceptual models are built before the project actually begins and are used to develop the scope and elements of the research effort. The model is not a simulation model, but a visual representation of the major components of the system. The model will be based on the habitat elements used in the "Matrix of Pathways and Indicators." This allows us to use a similar approach for all elements of the project.

The conceptual model is desirable as it serves to guide and focus thought. At this phase the models will be generated individually, then the third model integrating the first two will be developed. This model will show the components of the ecosystem with associated City activities and their potential impacts. These models may be generated with the available information, as they are quite simple and only conceptual in nature.

Using the models to frame the assessments will streamline the process. Any operations or procedures which do not have an impact on properly functioning condition of the aquatic habitat, or that do not result in the taking of a listed species need not be considered in the context of this project. This information will be available for future analysis, however.

General Data Evaluation and Assessment Protocols

The evaluation of human activities will begin with watershed-level or “coarse” filters to identify activities that have a potential impact on habitat and to eliminate activities with no impact. Finer filters will be used to measure and quantify more precisely the degree and nature of impacts on fish habitat. See the Appendix for descriptions of how these activities may be carried out.

It is important that the method be able to quantify impact, so a numerical score can be calculated for each stream reach. It is also important to weight the activities in order to determine the relative contribution of each activity to habitat degradation.

A matrix will be developed for each category. An Excel spreadsheet lends itself to this process. All staff will use the same matrix when evaluating the data and calculating the total score for each stream reach. Each cell in the matrix will have a formula that multiplies the raw score for a particular data element/activity/program with the weighted rating for that particular data element/activity/program. The cell totals will be summed for a total reach score.

Once the team members responsible for a particular category of data/activity/program prepare total stream reach scores, they will be given to the Aquatic Task Manager. The Aquatic Task Manager will review the scores and make adjustments based on best professional judgement. Stream reach scores will be combined to produce an overall stream reach rating. Each stream reach will be categorized into one of the three categories: properly functioning, at risk, or not properly functioning. This information will complete the analysis for Phase One and become the basis for identifying mitigation in Phase Two. Weighting will be provided through the Aquatic Task Manager’s basic knowledge of urban stream function and the importance of each category to proper functioning condition.

Scoring and Weighting Factors

Direct (occurring within the stream/riparian corridor)

Indirect (input through air or stormwater runoff)

- a) stormwater system
- b) overland flow
- c) air pollution/deposition

Levels

Direct- more heavily weighted 3X multiplier

Indirect

- a) stormwater 2.5
- b) overland flow 2.0
- c) air pollution/deposition 1.5

Duration		Magnitude (spatial)		Intensity (effect)	
Long-term	3	Watershed	3	high	3
Short-term	2	Stream reach	2	medium	2
Episodic	1	Single Point	1	low	1

Intensity levels are determined by the effect on habitat or organisms. An action causing a permanent alteration in habitat, or any mortality of listed species is considered high. An action causing a reversible change in habitat condition is considered medium, and an action causing a one-time disturbance is low.

EXAMPLE OF DATA ANALYSIS METHODOLOGY

Stream to be analyzed - Dixon Creek

Watershed-level Analyses - GIS and aerial photograph interpretation

- Total impervious surface
- Current Municipal, Residential, Commercial, and Industrial land use mix
- Riparian buffer continuity
- Barriers to fish movement
- Surface road data

Dixon Creek will be subdivided into three zones based on larger-scale changes in stream geomorphology. Analyses similar to the above will be conducted. This will involve breaking down existing information into the necessary components. These subdivisions will be further broken down into reaches. Reach division in this case will utilize the methodology described in the stormwater master plan.

Reach-level analyses - All GIS and aerial photograph interpretation, except instream habitat analyses.

Data to be collected:

- Impervious surface
- Land use patterns
- Riparian buffer width
- Riparian buffer connectivity
- General instream habitat features: The attached stream protocols will be followed at the Phase One level.
- Barriers/bridges
- Location of parks
- Location of City infrastructure facilities (maintenance yards, fire halls, police stations, etc.)
- Habitat assessment areas
- Storm sewer outfalls
- Street density

At the next level of scale, more detailed analyses will be done on smaller areas of the system.

Habitat Assessment Areas

These are stream reaches upon which detailed habitat assessment will be done. The attached stream protocols will be followed at the Phase Two level. Temperature loggers will be installed in these reaches.

Riparian buffer analyses. The attached protocols (see Appendix) for detailed riparian analysis will be used.

STREAM HABITAT DATA ANALYSIS

The project will begin with a detailed breakdown of fish habitat features/conditions for each of the streams in Corvallis. It is anticipated that, for instance, habitat conditions and fish use will be different for Dixon Creek, as opposed to the Willamette River. The analysis will use as its template the “Matrix of Pathways and Indicators” developed by the National Marine Fisheries Service. This enables the team to use the same techniques as the NMFS as a framework for the major habitat categories. Further breakdown into specific elements (habitat characteristics, impacts and pathways) will follow, along with conditions for establishing degraded, at risk, and properly functioning conditions, and the pathways for arriving at those conditions.

Information needs to be gathered and processed at easily understood levels of spatial scale. Therefore, the initial scale for information collection and quantification will be by stream basin. We will be utilizing the format presented in the Corvallis Stormwater Master Plan to deal with reach designations for the interior streams. The Mary’s River will be dealt with in a similar fashion; however, reach designations will be made using stream geomorphic features. The Willamette River will be treated slightly differently, because Corvallis has responsibility only for the section bounded by the urban growth boundary (UGB) but does have water quality issues.

Some analyses will require no further subdivision. If appropriate for the desired analysis, the stream basins will next be subdivided into upper, middle, and lower, depending upon gradient. These artificial divisions will be further subdivided into stream reaches. Stream reaches will be selected for more detailed habitat analysis using appropriate survey sampling techniques. Reaches will then be evaluated and weighted for the relative impact the activity has on habitat. That information will then be relayed to the Aquatic Task Manager, who will make determinations regarding the three levels of impact and response: properly functioning, at risk, and not properly functioning. The information provided by the National Marine Fisheries Service (NMFS) in its publication “Evaluating Habitat at the Watershed Scale” will be used in this analysis. Response programs in Phase Two will be based on stream designations.

Initial Assessment (Phase One)

- Determine the City activities/programs that need to be evaluated. We will break the programs down to discrete pieces to evaluate. By doing so, we may find overlaps between the data element needs that will reduce overall effort.
- Determine the data elements/documents necessary for assessment of baseline conditions and impacts of City activities to be collected. The elements include the Environmental Services data and how it fits into the other data.

- Determine the raw score range for the data elements. They should have the same range for all data.
- Assign the raw score range for each data element.
- Assign weights.
- Determine scores for programmatic elements.
- Determine the reaches to be studied.

SHAPIRO Environmental Services staff will collect habitat information to provide the baseline assessment of the City's aquatic habitat conditions. The initial assessment will use established stream and riparian habitat assessment protocols (See Appendix) to determine the baseline condition. Phase 1, Task 2 contains the essential elements of this phase. Habitat elements, pathways and impacts are outlined below, with some textual elaboration. These are identified to assist the Habitat Baseline Assessment, which will also be used to inform the Regulatory and Environmental Services Analyses.

Habitat Elements

I. Instream conditions

A. Flow

1. Periodicity

- a. Storms-addition of water
- b. Groundwater recharge-subtraction of water

2. Erosion

- a. Normal for undisturbed stream
- b. Condition for disturbed stream

B. Sediment (addition of fines)

- 1. autochthonous
- 2. allochthonous

II. Riparian

A. Buffer Size (width and height)

B. Buffer Composition

C. Buffer Continuity

III. Water Quality (Contaminants)

A. Point source

- 1. Industrial
- 2. Commercial

3. Residential

4. Municipal (wastewater)

B. Non-point

1. Agriculture

a. Fertilizer

b. Pesticide

c. herbicides

2. Horticulture (lawns and gardens)

3. City activities (traffic, etc.)

4. Stormwater injection

IV. Instream Habitat Conditions

A. Pool-riffle habitats

1. pool quality

2. pool quantity

3. width to depth ratio

B. Substrate

1. type

2. embeddedness/percent fines

C. Cover

1. instream

2. Large Woody Debris (LWD)

D. Shade

E. Temperature

F. Water quality

G. Off-channel habitat/refugia

V. Watershed Elements

A. Impervious surface

1. Present

a. municipal

b. residential

c. commercial

d. industrial

- e. transportation
- 2. Proposed/projected
 - a. municipal
 - b. residential
 - c. commercial
 - d. industrial
 - e. transportation
- 3. Physical barriers
- 4. Floodplain connectivity
- 5. Riparian continuity

Impacts

I. Instream Habitat conditions

A. Channelization

1. Increase in need for stormwater treatment, as encroachment occurs in floodplain leads to channelization as streams become stormwater conduits. Removal of large, woody debris (LWD) from channel increases channelization.
2. Loss of floodplain and restriction of channel causes loss of off-channel habitat
3. Channelization causes increased velocity, increased down-cutting erosions, severing connections between stream flow and groundwater, causing problems in the hyporheic zone, and increasing problems for spawning and rearing fish.

Channelization degrades:

1. instream cover
2. LWD
3. Off-channel and other refugial habitat
4. Riparian conditions
5. Floodplain connectivity
6. Food resources
7. Substrate
8. Instream habitat quantity, diversity, and quality

B. Flow

Properly functioning condition consists of flows governed by infiltrated groundwater, overland flows, and sources flows (springs, lakes, etc). This condition means that system hydrographs have fewer peaks, over a longer period of time, i.e. bankfull flows occur on the order of 2 per 5-year intervals. Systems with heavy impacts have these events several times in a year.

Impacts

1. increased in-stream erosion as the stream equilibrates to the new flow regime. this leads to loss of instream habitat features (e.g. under-bank cover) through erosion, and transport of large woody debris.
2. Increased fine sediments initially, while the stream is equilibrating (0-20 yrs). Once the stream as reached its new equilibrium, fines actually decrease (assuming no channelization-this activity stops the channel from reaching equilibrium), and no further development.

Habitat affected by flow changes

The principal effect is to widen the channel. This occurs because the stream must accommodate greater flows. Bankfull width increases, pools tend to fill in. Stream flow

slows and temperature increases, due to the slower passage, loss of riparian shading, and greater surface area to be heated. Continued erosion causes the loss of overhanging cover in the pool areas. Increased sedimentation and the subsequent slowing of flows and filling of pools by finer sediments causes a loss of spawning and rearing habitat. As the channel reaches equilibrium, the sedimentation problem goes away as the higher flows act like flushing flows. This leaves coarser sediments, that may be better for spawning activities, but this activity is diminished if the connection between the groundwater flows and surface flows is severed as the result of changes in hyporheic zone activities. The higher flows may also wash fish away or lower flows may strand them in summer when rearing is important.

Pathway for the changes

The chief pathway for this change is through increased impervious surface contributing to greater surface runoff and less infiltration. This leads to higher flows and a “flashier” hydrograph. Secondary pathways could be the loss of riparian habitat and decreased groundwater flows-the latter as at least the partial result of reduced infiltration of stormwater. Increased impervious surface is the direct result of increased development of all types. The more concentrated the development, the greater the amount of impervious surface. At a level of about 10% Total Impervious Surface, stream habitat begins to suffer. After a stream reaches equilibrium with its flows, riparian issues become more important.

C. Instream Habitat Structures

1. Increase in impervious surface leads to increase in flows, increase in periodicity.
Increase in in-stream erosion breaks down habitat structure
2. Removal of large woody debris removes habitat structure
3. Flushing flows create problems for juvenile fish movements
4. Decrease in habitat diversity through filling in of pools creates problems for rearing fish
5. Changes in stream geomorphology alter temperature regimes negatively.

Increase in impervious surface changes

1. substrate composition (more fines initially, later coarse sediments)
2. flow regime/hydrography (more flashy-higher highs, lower lows)
3. pool-riffle ratios
4. pool quality
5. water quality (addition of pollutants)
6. refugia
7. riparian buffer condition
8. temperature

D. Riparian Areas

Properly functioning condition consists of buffer widths, continuity, and structure sufficient to provide streambank erosion protection, large woody debris, filtration of overland flow, and shading. Densely vegetated riparian areas act as filters for contaminants and nutrients, as

well as infiltration areas to regulate flows. Riparian areas also provide large woody debris, an important contributor to instream habitat structure and formation. Riparian areas also provide shade for the adjacent stream, prevent bank failure, and create instream bank cover for fish.

Riparian Condition (decreased buffer width tends to act like impervious surface) impacts

1. increased instream erosion-loss of habitat structure and diversity
2. Increased Horton (overland) flow of water and pollutants
3. Higher temperature (loss of shade)
4. Loss of LWD which leads to loss of instream structure.

Riparian condition pathways

1. insufficient buffer size or structure diminishes the functions of infiltration and filtration. If the riparian zone consists of lawns or manicured grasses, it can act as a more impervious surface.
2. The presence of large woody debris is diminished by lowered riparian connectivity, as is the structure of the riparian zone. A zone with no large trees will contribute no large woody debris to the stream channel
3. riparian areas with shrubs or young trees provide less of a shade function to a stream. Grasses shade even less and manicured grasses provide no shade function
4. any vegetation on the bank will provide protection against erosion, although quality varies.

E. Barriers

Barriers to fish movement include such structures as culverts and pop-up dams. Culverts create an environment where flows become considerably more powerful, but also may serve as low-flow barriers to movement. Dams without fish passage, serve as blockage to movement during all flow regimes.

1. don't allow adult fish access to spawning habitat
2. don't allow juveniles access to rearing/refugial habitat
3. don't allow juveniles downstream passage

E. Water Quality

Contaminants in the water may act as a direct effect, through toxicity to one or more life stages of the fish, or other elements of the food web, or through indirect effects, such as sublethal impacts on growth and vitality. These impacts are difficult to separate from background individual variation within a population, as well as from seasonal changes.

They can, however, be highly important in the long-term survivability of the population, as their impact tends to be on lifetime reproductive output.

1. direct toxicity to
 - a. eggs
 - b. juveniles
 - c. adults
 - d. food supply
2. Indirect effects(decreased reproduction and growth)
 - a. eggs
 - b. juveniles
 - c. adults
 - d. food supply

Ecological Data To Be Analyzed in Phase 1, Task 2 and Data to be collected in Phase 1, Task 3

1. City of Corvallis Stormwater Master Plan
2. City of Corvallis Stormwater Pollution Prevention Plan
3. City of Corvallis-Raw Water Data
4. City of Corvallis Stream Monitoring Data
5. Biological Opinion for the Corvallis Bank Protection in the Willamette River
6. Corvallis Stream Walk Summary
7. OSU research data on Corvallis streams
8. Stream and Riparian Field Data Collections

REGULATORY ANALYSIS

Shapiro planners will collect and evaluate the following information.

- **Actual land use:** Residential, industrial/manufacturing, commercial. Is it important to discern differences in intensity of land use for residential, industrial, and commercial areas? If so, the information should include the amount of land and density of land used for each of the land use types. For instance, low-density residential housing may have a higher impact on fish habitat because of yard maintenance issues. However, higher residential density may have greater amounts of runoff from impervious surfaces. Industrial land use could be heavy or light, and depending on the activity, could have different impacts. The same is true for commercial land use. We will utilize the coarse figures listed in the Stormwater Master Plan to make these determinations.
- **Zoning:** Designates allowed land use. While zoning does not necessarily mean that all land in a particular zone is of the type zoned, it does let planners know what may occur in the future. A somewhat rough projection here will be sufficient for the purposes of the habitat assessment.

- **Municipal Code:** Designates allowed activities and practices within the City. The development code will be reviewed to determine what is allowed in development, zoning, and so on. Planners will determine how the municipal code affects fish based on what is allowed.

SHAPIRO planners will need to know basic concentrations of development within a watershed, subbasin, and/or at the reach level. We may not need to go down to the level of reach, as the data gathered at that level may be no more beneficial than at a higher level of resolution. A simple percentage of land use type will likely be sufficient. The following assumption will be made concerning weighting of land use: industrial is worse than commercial, which is worse than residential, which is worse than undeveloped, because of the relative degree of impervious area and runoff pollutants.

The detailed information will be more useful for restoration purposes. Codes will be examined using the same approach as the programmatic elements of the study. The activity will first be assessed as to whether or not an effect exists. A determination as to whether or not the effect is direct will be made next. This will act as a weighting factor. The next level of assessment will be to determine the duration, intensity, and magnitude of the effect. This will allow us to provide for weighting of acute situations as opposed to more chronic problems. Magnitude will be assessed on a geographic scale. The levels of scale will be the same ones used in the initial scale determinations. Small-scale events can be multiplied up through the scales to reflect a watershed-level approach. Intensity will be a value judgement as to the nature of the activity. Duration will be chronic or acute, with allowances made for time intervals between. Multiplying all three elements together will provide a score for each activity.

Analysis of City Regulatory Activities

The objectives of this project are to: 1) determine, through review of City ordinances, administrative rules, and adopted policies (“regulations”); those activities that could cause a beneficial or negative impact to upper Willamette Spring Chinook or its habitat; 2) identify the regulatory “gaps”, including those activities currently unregulated by the City, or any other regulatory entity, which could have an impact on Willamette Spring chinook or its habitat; and 3) provide a measure of the relative magnitude of each impact.

The SHAPIRO team’s approach to this task is to form a multi-disciplinary team of planners and scientists, to bridge the gap between science and planning. SHAPIRO’s science staff will describe the habitat elements, the pathways by which they can be degraded and the means by which they can be protected and enhanced. SHAPIRO’s planning staff will then take this information and use it to analyze the regulatory activities of the City. Both groups will then determine the magnitude of any impacts, and present the results to the TAC for their use in further planning efforts.

This element of the project will begin with a detailed breakdown of fish habitat features/conditions for each of the streams in Corvallis. It is anticipated that, for instance, habitat conditions and fish use will be different for Dixon Creek, as opposed to the Willamette River.

The analysis will use as its template the “Matrix of Pathways and Indicators” developed by the National Marine Fisheries Service. This enables the team to use the same techniques as the NMFS as a framework for the major habitat categories. Further breakdown into specific elements will follow, along with conditions for establishing degraded, at risk, and properly functioning conditions, and the pathways for arriving at those conditions. The conditions for the analysis –the habitat elements, impacts and pathways will be those established earlier in this document.

At the same time, the Regulatory Analysis team, assisted by the project manager, will use a checklist procedure to initiate a first-level filtering of the regulations. The major question to be asked will be “Could the actions carried out under this regulation have any effect on the stream habitat in the City of Corvallis?” This will eliminate any regulations with no impact on fish habitat. The remaining regulations will be classified into “possible” or “definite” impact categories, to be analyzed in the next task.

The analysis phase will consist of assessment of the City’s regulations for potential impact upon listed species. Each component of the regulations would be evaluated for its potential impact on critical habitat, listed species, and properly functioning habitat conditions, as the NMFS has identified these major areas as being critical for their definition of take under Section 9 of the ESA.

These activities will be assessed as to their perceived impact (beneficial or detrimental) on Properly Functioning Condition within an appropriate geographic scale designation. The pathway for the impact will be listed as well. Included in this analysis will be an assessment of regulatory “gaps”, where the City could influence the protection and recovery of listed fish and

The critical element of this portion of the project is to take the information gathered from the regulation analysis and create a simple, effective tool for the evaluation of the potential for ESA compliance/non-compliance. A matrix will be developed listing the regulation, its scope/spatial scale, duration, and intensity and the potential impact this regulation would have on the parameters listed in Task 1.

The matrix will be organized by habitat element and general regulatory category, with specific regulatory actions listed underneath. The possible impact will be listed, with an indication as to whether the impact was a direct result of the action or indirect (if intermediate steps occurred). Direct effects are those occurring in the stream corridor or riparian buffer. Direct effects offer little chance for an intermediate action to be taken to eliminate their effect. The potential intensity of the impact will be assessed at this time, as well as the area of impact.

In assessing the magnitude of City regulatory impacts on listed salmonids and their habitat, it is important to be as quantitative as possible. Therefore, we have chosen a system similar to that used in numerous environmental impact assessment studies to make this magnitude assessment. The approach described below divides the impacts into the factors of interest and uses clearly defined and repeatable categories to determine their magnitude.

Each activity will be scored, using a standard three-point scale, as to the importance of its perceived impact on each element of habitat functioning.

Scoring and weighting will be done using an assessment of the duration, spatial scale, and intensity of the action, as stated in the general data analysis and evaluation section above.

The activity will first be assessed as to whether or not the effect is direct. This will act as a weighting factor. The next level of assessment will be to determine the duration, intensity, and magnitude of the effect. This will allow for weighting of acute situations as opposed to more chronic problems. For example, a single construction project with poor or non-existent erosion control mechanisms, resulting in the release of sediment to a stream during a heavy rainfall event would constitute an acute situation. New construction, resulting in increased impervious surface, with no appropriate increase in stormwater mitigation would constitute a chronic problem.

Spatial scale of the impact will be assessed using geographic scale, i.e. watershed-level, stream reach-level (or neighborhood), and individual points. Small-scale events can be multiplied up through the scales to reflect a watershed-level approach. This is important, as despite the city-wide nature of the regulatory activities, their impact may vary on a scale considerably smaller than that. Intensity will be a value judgement as to the nature or concentration of the activity. Multiplying all three elements together provides a score for each activity, allowing the process to be replicated by individuals not involved in the initial assessments.

The products for this portion of the project will consist of the following: a matrix displaying city regulations on one axis and natural system impacts on another. For non-programmatic activities, this matrix will use a reach x reach format. The cells in the matrix will contain the magnitude of impact for each major area of City operations. The draft and final products include a discussion of the potential impact of City regulations on listed species and their habitats, and any regulatory “gaps” found during the analyses.

Example of analytical procedure for Regulatory Analysis

Impact

Increase in morbidity, caused by heavy metals, thereby negatively influencing growth and lifetime reproductive output, having an impact on population size

Pathway

Stormwater input, whether overland, through pipes or injection.

Source

Traffic on streets

Regulation/activity influencing

Development creating traffic without concurrent treatment of stormwater.

Magnitude Assessment

Direct/Indirect, depending upon location

Duration-chronic	2 pts
Intensity-low	1 pt
Spatial scale-widespread	<u>3 pts</u>
Total	6 pts

Weighting component. In riparian buffer zone X3

Outside riparian (stormwater) 2X

Documents/data to be analyzed in Phase 1, Task 2.

1. City of Corvallis Buildable Land Inventory and Land Need Analysis
2. City of Corvallis Park and Recreation Facilities Plan
3. City Council-Approved Corvallis Comprehensive Plan
4. City of Corvallis riverfront Commemorative Park & Riverbank Restoration Plan
5. South Corvallis Area Refinement Plan
6. City of Corvallis-Flood Insurance Rate Map
7. Proposed West Corvallis-North Philomath Plan
8. Corvallis Urban Fringe management agreement
9. Green Neighborhoods Planning and Design Guidelines
10. Benton county comprehensive Plan
11. Benton county Development Code
12. Benton county General Zoning Map
13. Parks inventory-City of Corvallis

ENVIRONMENTAL SERVICES ANALYSIS

The City requires a process to determine which of their operations and maintenance procedures are in compliance with the ESA of 1973 sections on take of listed species. The final 4 (d) Rules provide some latitude for developing this compliance. The recent 4(d) final rules dealt with limits applied to activities in municipal, residential, commercial, and industrial (MCRI) programs, ordinances, planning efforts, and regulations. The chief concern at this time for the city of Corvallis is with city programs and the impact these programs have on listed species.

The objective of this environmental review services project is to accomplish the following goals:

- Develop an assessment tool that evaluates City service activities that may harm ESA listed fish (spring chinook salmon),
- Evaluate City activities/programs against the baseline information to determine the degree of impact on listed fish habitat through interviews of work groups who have been specifically appointed for this purpose,
- Develop a process to rank and prioritize City activities and programs based on the degree of fish habitat impact,

- Provide the results of the assessment tool in both a report and presentation format to the TAC in order to explain the assessment process, results, and implications of City programs/activities and impact on ESA listed fish,
- Indicate to the City how this initial investigation, identification, and assessment process can be integrated in the City's overall ESA 4(d) Rules compliance process.

Aspects of City operations to be analyzed in this section include the following:

- **Stormwater:** Volume and location of stormwater outfalls. Content of stormwater could be analyzed, but we should be able to get a general breakdown from the literature and the nature of development in the area. Again, given the NMFS matrix as a guideline, chemical contaminants do not necessarily need to be listed, although they can be referred to. If the information is easily obtainable, for example the National Pollutant Discharge Elimination System, we should get it.
- **Sewer:** Volume and discharge locations for Corvallis area. As per above.
- **Water:** Discharges of treatment chemicals: volume and location. We need to know about water intake locations and impact. We need to know the status of any diversions, screened or unscreened, as these are specifically noted in the 4 (d) rules.
- **Roads:** Road maintenance activities. This is a programmatic evaluation, as we cannot calculate the impact on all the roads. There are county and City roads, as well as state roads, within the project area. We will need the same information from each jurisdiction. KCM should calculate the road surface area/level of scale and then determine runoff impacts from road maintenance, if possible. We may be able to pick this up in the stormwater runoff calculations. We also should be aware of any activities, for example, snow maintenance activities such as salting or sanding, that may not be covered in the Oregon Department of Transportation (ODOT) Road Maintenance Guidelines.

Review of City Operations and ESA Compliance

Another step in developing Corvallis's 4(d) compliance plan has been to establish a process to assess current city operations.

The step following the initial model development developing the pathways between habitat elements, impacts, and pathways will be to assess the various manuals used by the City in conducting its operations. Assessment will be made using the general model discussed earlier in this document. It may be necessary to interview workgroups of city personnel. The workgroups would be identified and formed by the Technical Advisory Committee from the City of Corvallis. Questions will be framed in such a fashion as to address city operation from a general impact framework. These questions will be guided by the conceptual models –which will have identified both general linkages and ones particular to the 4(d) process.

The assessments are designed to relate current practices of city operation and maintenance to potential ESA issues. It is likely to be necessary to interview city operations staff to assess field activities. A three-person team (two interviewers and a recorder) will conduct interviews. Questions will be about municipal, residential, commercial and industrial activities. Questions will be use a checklist of activities format. A checklist is highly useful for both the analysis and interview phases as it enables the analysis team/questioners to organize themselves in a systematic fashion about the array of impacts and enables concise summarization of these effects. The actual interview will consist of a series of general questions related to operations and maintenance activities in the workgroup's area of responsibility. Following this, the questions will refer directly to specific activities undertaken by the members of the group in the performance of their job. These will be designed to determine the types of activities, their timing, and the end product of such actions.

Sample questions for interview session focused on stormwater issues are outlined below:

A) Stormwater system/Storm sewer maintenance:

- 1) What process is used to clean culvert and pipes?
- 2) Are chemical methods used to remove blockages?
- 3) What are these chemicals?
- 4) Do they enter the stormwater system and thus the streams?
- 5) How often are they inspected?
- 6) Are downstream debris traps used during cleaning?

B) Catchbasins and Inlets:

- 1) How often are catchbasins inspected?
- 2) How often are inlets inspected?
- 3) Does the city have any self-cleaning storm drain inlets? If so, where are they?
- 4) How is debris disposed of?

C) Drainage Ditch Maintenance:

- 1) How often are channels and ditches inspected?
- 2) How often are they mowed?
- 3) What is the cleaning procedure?
- 4) How are sediments disposed of?

D) Stream Channels:

- 1) How often are they inspected?
- 2) What criteria are used to determine if cleaning should occur?
- 3) What is the process for instream work? Does it include erosion control, etc.?

E) Detention Pond Maintenance:

- 1) Where are there detention ponds?
- 2) How often are they cleaned/maintained?
- 3) Do they have a vegetative buffer?
- 4) Are drain times monitored to maintain water quality?
- 5) Where are sediments disposed of?

The following are examples of anticipated pathways for impacts of stormwater maintenance operations on the existing habitat conditions:

A) Increased flows directly into stream

- Changes in the stream hydrograph away from the PFC-stream becomes more flashy
 - Increased erosion potential on streambanks
 - Increased instream erosion potential
 - Increased sediment carried into the stream
 - Increased likelihood of deposition on important fish spawning and rearing areas

B) Increased sediment carried into the stream

- Increased likelihood of deposition on important fish spawning and rearing areas

C) Removal of streamside vegetation

- Increased erosion of stream banks and sedimentation into stream
- Increased instream temperatures
 - Increased nutrient inputs into stream-potentially degrading water quality

The critical element in this project is to take the information gathered and create a simple, effective tool for the evaluation of the potential for ESA compliance/non-compliance.

The analysis phase will consist of the assessment of the City's operations and maintenance procedures for potential impact upon listed species. Each component of the operations would be evaluated for its potential impact on critical habitat, listed species, and properly functioning habitat conditions, as the NMFS has identified these major areas as being critical for their definition of take under Section 9 of the ESA. The process will use the same template of habitat elements/impacts/pathways described earlier, and the same scoring and weighting elements as the Regulatory Review.

An intermediate matrix will be developed listing the activity its scope/magnitude/duration, and intensity and the potential impact this activity would have on the above-mentioned parameters. A matrix provides a number of advantages over the checklist used in the interview process. A checklist doesn't allow for a statement of likelihood of occurrence of any of the actions, and tends to be qualitative and subjective. Therefore, they allow for no subsequent data analysis. A matrix provides a two-dimensional view of the potential impacts of a project, as it allows a listing of actions along a second axis.

The matrix will be organized by general area of operations, with specific activities listed underneath. The possible impact will be listed, with an indication as to whether the impact was a direct result of the action or if intermediate steps occurred. The potential intensity of the impact will be assessed at this time, as well as the area of impact.

Following this evaluation, a second matrix will be generated. This matrix will again be a listing of city procedures, much the same as the first matrix, but will be much less complex, containing only the procedure, the impact, and an assessment of its intensity. This final matrix will be

utilized in the generation of a text-based tool for assessment of City processes for potential ESA compliance/non-compliance.

The next step is to evaluate the likelihood of occurrence for each event using the weighting process described in the General Data Analysis and Assessment Protocols section of this document.

The final product for this portion of the project will consist of the following: a matrix displaying city operations and maintenance procedures on one axis and natural system impacts on another. The cells in the matrix will contain the likelihood of impact for each major area of City operations. The accompanying text will discuss the magnitude of each impact and the feasibility of actions to alter or mitigate said actions.

The final product will also have text discussing the potential for impact of City operations and maintenance policies and procedures on listed species and their habitats, and the feasibility for changes. It is expected that at least two levels of feasibility exist. There are those practices for which there will be no question of impact and little or no doubt as to the necessity for change. These are likely to include such activities as the dumping of stormwater pipe cleaning chemicals directly into the stormwater system. The problem is clear-cut, as is the solution. It is also likely that, for some practices, it will be much more difficult to determine the potential for effect and the level of their impact upon the system. An example of such an impact might be the aerial suspension of particulates during street-sweeping operations. A process such as this which has no direct impact on aquatic systems, but may, nonetheless, have an important though indirect effect will be harder to diagnose.

Example of analytical procedure

Impact

- Increased erosion of stream banks and sedimentation into stream
- Increased instream temperatures
 - Increased nutrient inputs into stream-potentially degrading water quality

Pathway

Stormwater input, whether overland, through pipes or injection.

Source

Removal of streamside vegetation

Activity influencing:

Stormwater maintenance

Magnitude Assessment

Direct/Indirect, depending upon location

Duration-log-term	3 pts	
Intensity-high	3 pt	
Spatial scale-widespread	<u>3 pts</u>	
Total	9 pts	
Weighting component.		In riparian buffer zone X3

Documents to be analyzed in Phase 1, Task 2.

1. City of Corvallis Stormwater Master Plan
2. Corvallis Transportation Plan
3. City of Corvallis-Stormwater Pollution Prevention Plan
4. Urban Stream Maintenance Guidelines
5. Catch Basin Cleaningj Program
6. Sanitary Sewer Flushing Program
7. City of Corvallis-Raw Water data
8. Valve Exercising and Water Line Flushing program
9. Design Criteria Manual for Public Improvements
10. City of Corvallis Standard Construction Specifications

PROGRAMMATIC CONCERNS (REGULATORY AND ENVIRONMENTAL SERVICES)

Programmatic issues will also need to be addressed. Not all the programs/activities lend themselves to a quantitative measure. Private citizen behavior, Parks and Recreation mowing schedules, pesticide management, open space management, and fire and police fleet maintenance may not have specific schedules that we can assign a number; they can only be regarded as programmatic. To do otherwise would be a poor way of analyzing the data, as we would be forcing a classification onto something that has no logical structure for that action.

Parks and Recreation

- **Maintenance:** This is a programmatic evaluation. We identify maintenance schedule (mowing, herbicide and pesticide application, etc.) for each park within the appropriate level of scale. Parks not specifically within the riparian zone of a stream could be treated programmatically. Parks within a riparian zone will necessitate examination of specific activities.
- **Open Space/Parks:** Planners will need to identify the location of all parks and open space. They will also need to determine the amount of impervious area and open space for each

park. A general idea of how much of the park surface area is lawn will also be necessary, because it can act as impervious surface.

City Maintenance Yards/Motor Pool (similar programmatic treatment as Parks)

- **Maintenance Yards:** We will need to identify the location and size of the City maintenance yards and motor pool.
- **Maintenance Activities:** This is a programmatic description of the activities performed at all yards.

Police and Fire Services (similar programmatic treatment as Parks)

- **Police Stations and Fire Houses:** We will need to identify the location of each police station and firehouse.
- **Maintenance Activities:** This will be a programmatic description of the activities performed in all locations.

Private Citizen Behavior

This will be a programmatic description of private citizen behavior that could affect fish habitat. The activities could include car washing; auto maintenance; fertilizer, herbicide, and pesticide application; and so on

Proposed Analysis of Programmatic and Citizen Behavior Features

Citizen behavior: Lawn mowing.

This is an activity that occurs throughout the city, in all watersheds, and is both direct and indirect. To approach it on a reach x reach basis, would be uninformative. Therefore, it is simply considered to occur everywhere, and will be treated the same in the scoring. The only difference will be in the weighting. It is still important as to whether the effects are direct or indirect.

Magnitude-high 3 pts

Intensity-low 1 pt

Duration-low 1 pt

Total 5 pts

Weighting component. In riparian buffer zone X3

Outside riparian (stormwater) 2X

ATTACHMENTS

Summary of Stream Habitat Inventory Protocols

The stream habitat inventory will be developed by SHAPIRO to assess the aquatic habitat of streams in the City of Corvallis and to gather baseline data for the purpose of future monitoring activities. The inventory protocol has two phases. Phase One consists of surveying all existing fish habitat by estimating and measuring the physical dimensions of individual habitat units (pools, riffles, etc.) and characterizing important features (i.e., substrate, fish cover, and large woody debris [LWD]) within each unit. Phase Two involves taking detailed, site-specific data regarding channel morphology and substrate composition to establish a baseline for future monitoring activities.

PHASE ONE AQUATIC HABITAT INVENTORY

The following information will be gathered according to protocols set forth in the Oregon Department of Fish and Wildlife's (ODFW's) *Aquatic Inventories Project, Stream Survey Methods*. Adaptations of this protocol are noted with asterisks (*) and briefly explained below.

Stream reaches will be divided into individual geomorphic channel units, or habitat units. These habitat units will be recorded, along with the following attributes for each unit:

- Length, width, and bankfull width: The surveyor will estimate these dimensions and later measure approximately 10% of them to obtain a correction factor. Both width and bankfull width will be taken at locations that represent an average value for the habitat unit as a whole. In small tributary streams, where breaking a channel into individual habitat units became impractical, entire sections of stream will be categorized as small stream unit types.
- Depth: The surveyor will measure the maximum depths of all habitat units with a surveying staff.
- Gradient: Gradient will be estimated with a clinometer.
- Dominant substrate, subdominant substrate: Rather than estimating the percent composition of each substrate class, the surveyor will make ocular estimates of the two most common classes of substrate in each habitat unit.
- Bank class: The stability and stabilizing features of banks will be identified and recorded according to the bank classes identified in the ODFW protocol.
- Percent undercut bank: The surveyor will estimate what percentage of total streambank is undercut.
- Percent fish cover and dominant cover type: Percent cover is a comparative estimate of the area within a habitat unit that offers refuge to salmonid species versus the total wetted area of

the unit. It is a gross measure of the quality and usability of the habitat for fish. The dominant cover type refers to the type of structure providing the majority of cover within each unit. Cover types include: LWD, undercut banks, overhanging vegetation, depth (when a unit is greater than 0.75 meter deep), and substrate. The surveyor will make an ocular estimate of the percentage of total wetted area with cover potential for rearing or adult salmonids.

- Number of LWD pieces: The number of pieces within the ordinary high water mark will be counted at every habitat unit. LWD will be defined as any piece of wood within the wetted channel that is both greater than 30 cm in diameter and over 3 m in length.
- Descriptive comments of important habitat features: Comments regarding the location of the habitat unit, the presence of salmon carcasses, survey decisions, and special habitat unit attributes will be recorded.

The field data from the survey will be used to break the stream into reaches according to habitat characteristics and channel morphology. The data for each reach will be analyzed to characterize the habitat in each reach, and to identify concerns and possible habitat improvement opportunities.

PHASE TWO

After stream reaches are identified, detailed substrate assessments and channel profiles will be made for specific sites within each reach.

Channel Cross-sectional Profiles

Lateral profiles of channel substrate and banks will be taken at selected sites within each reach. The location of each profile will be documented with photos, maps, and global positioning system (GPS). At least one riffle and one pool in each reach will be measured and plotted (if present). The data from both the cross-sectional profiles and the substrate sampling are intended to be used as reproducible indicators of changes in channel morphology and substrate composition.

Channel cross-sectional profiles will be obtained measuring the distance and elevation of the bank and stream substrates in relation to a fixed point at the top of the left bank. Measurements will be taken at all significant slope breaks and the edge of the wetted channel. Where slopes appear to be constant over large portions of the channel, measurements will be taken once every meter. All significant points between (and including) the tops of the banks will be measured. In instances where the top of one or both banks may be so high that vertical measurements to the bottom of the channel became impractical, profile measurements will be obtained only up to the ordinary high water mark. The horizontal and vertical components of the measurement will then be used to plot channel profiles with AutoCAD software.

Substrate composition will be sampled at least once in every reach. At each site, the surveyor will systematically collect 100 samples of the stream substrate by walking a zigzag path up the creek and identifying the class of substrate located at the tip of his boot. Substrate classification

will be according to the standards in the *Aquatic Inventories Project, Stream Survey Methods* (ODFW). Substrate data will be compiled to yield percent composition estimates for each substrate class.

Embeddedness of the stream substrate will also be evaluated at different points along the sampling path to make qualitative conclusions about the suitability of the substrate for spawning and egg incubation.

Water Quality Assessment

Objectives and Sampling Strategy

Monitoring water quality at fixed locations is necessary to establish baseline conditions for stream habitat surveys. We will sample a number of stream stations within the City's UGB. We will select locations for monitoring stream flow, water chemistry, attached algae, and aquatic invertebrates.

Flow Measurements

Measurements of flow at the stations will be made where turbulence is minimal and the flow is perpendicular to the cross-section. Cross-sections will be established using a measuring tape strung across the stream and clamped on each side at the bankfull level. The cross-sectional area will be divided into subsections, and measurements will be made in equal increments. In most cases, measurements will be made at 1-ft intervals across the stream. Mean velocity for each segment will be estimated by measuring velocity at 0.6 depth from the surface in water less than 2.5 ft deep, which will not be exceeded at any of the stations. Readings will be made with the meter directly in the current and free of interference from obstructions. The Swoffer flow meter (Model 2100 series) will be allowed to stabilize before readings are made.

Water Quality

Field measurements of water quality will be made at the time of sample collection. Water temperature, dissolved oxygen, conductivity, turbidity and pH will be measured at each sampling site.

Benthic Invertebrates

The benthic invertebrates will be sampled at each stream station to document diversity as a reflection of water quality conditions using a Wildco bottom aquatic kick net with a frame opening of 18 in x 18 in and 900 micrometer net mesh. Silt and cobble substrates will be sampled representatively at each station. The sampling protocol will follow recommendations of Barbour (1999). Samples will be preserved using a 40% isopropyl alcohol solution. Samples will be sorted, and the analytical recommendations of Barbour (1999) will be used.

Scoring will be based on the categories in the NMFS matrix. Conditions will be rated as to properly functioning, at risk, or not properly functioning. A total score will be calculated for each spatial scale.

FIELD RIPARIAN ASSESSMENT AND INVENTORY

Before conducting the fieldwork, SHAPIRO will gather information necessary for a preliminary determination of riparian reaches and assessment of the riparian areas. Recent aerial photographs of the City of Corvallis urban growth boundary (UGB) will be used to plan stream assessments. SHAPIRO will assemble existing reference materials for the riparian inventory and assessment, including National Wetland Inventory quadrangles, and U.S. Geological Survey quadrangles. SHAPIRO will also assemble information showing fish presence from the Oregon Department of Forestry and Oregon Department of Fish and Wildlife (ODFW) Stream Classification Maps.

The study area map will be divided into hydrologic sub-basins, wetlands, and riparian reaches. Each riparian reach will receive a unique code identifying the sub-basin name and the position along the stream.

SHAPIRO will meet with City staff in a two-hour meeting to develop a strategy for obtaining access to private property. The City will provide updated GIS ArcView maps of tax lots within 100 feet of mapped stream boundaries with accompanying ownership lists. The City will prepare and send letters requesting permission for SHAPIRO to gain access to riparian areas and publicize the SHAPIRO work within the community. The City will also provide SHAPIRO with copies of signed letters of consent, a map showing parcels allowing or denying access, and updated comprehensive plan and zoning maps

FIELDWORK AND DATA COLLECTION

The DSL has developed a guide for conducting a riparian inventory focusing on the quality of the functional values of the riparian corridor with respect to Goal 5 natural resources, including: wildlife, water quality, and fish habitat. The Urban Riparian Inventory and Assessment Guide (Pacific Habitat Services, 1998; Riparian Guide) will be used as a basis for the functional assessment of riparian areas. The methodology will be modified to reflect the relationship with changes in stream character. For instance, riparian reaches will be divided according to road crossings and a more detailed characterization of the riparian areas will be prepared than that suggested by the Riparian Guide. These modifications will enable collection of data that can be used as baseline data for 4(d) rule compliance.

. SHAPIRO will first review existing information and prepare the preliminary mapping of riparian corridors on the base map/aerial photograph (Task 1). SHAPIRO will then conduct a field reconnaissance of the study area to verify and determine the width and character of existing riparian areas and document the vegetation species composition.

Assumptions:

- Assessments of riparian reaches will be limited to parcels with access permission.
- Riparian reach assessments on parcels that have denied access will be assessed from off-site. Off-site data collection will be limited to existing information, aerial photograph

interpretation, and observation from parcels that have allowed access and public access points.

- The potential tree height as the basis for the width of the riparian study area will be the dominant tree species existing in the riparian area at the time of the study. If no tree species are present, nearby reaches with riparian tree vegetation will be used to identify the tree species to determine the potential tree height.

In addition to information gathered in the field, existing information and reference materials will be reviewed to complete the characterization and assessment forms. Using the electronic base map provided by the City and the aerial photograph used in the inventory, SHAPIRO will map the riparian assessment areas based on potential tree heights of the dominant tree species as outlined in the Riparian Guide. SHAPIRO will prepare riparian inventory maps showing riparian assessment areas as a hard copy and in electronic (AutoCAD) form.

- Provide a description of riparian areas and their associated land uses within the study area
- Characterize the function and quality of riparian corridors related to water quality, flood management, thermal regulation, and wildlife habitat.
- Identify opportunities for riparian corridor improvement and restoration.

AERIAL PHOTO INTERPRETATION PROTOCOLS

Proposed Categories of Riparian and Stream Channel Condition Units (RCU)

PURPOSE AND BASIC APPROACH

Assumptions/Sideboards/Rationale

- Create units that could facilitate further divisions at a later time.
- Create units to match zoning districts.
- Units need to have significance related to salmonid and aquatic habitat.
- Model final riparian condition ratings toward ratings used by the NMFS for salmonid habitat; for example, functional, non-functional, or at risk, and so on.

Map Unit Delineations and Polygon Attributing

- Polygons are to be divisions within a 200-ft corridor on either side of a stream centerline for reaches delineated in the channel habitat type module.
- Riparian habitat components are the same as riparian map unit delineations.
- Each delineated map unit gets rated by a scoring scheme.
- Use underlined text in Table 1 as the formative element for polygon attributes.
- RCU Coding for polygon attributes: Upper case is column heading, and lower case is row category. For example: LUcom = land use commercial, SSsm = stream size small, etc.
- SHAPIRO will delineate channel reach breakouts in the channel habitat typing module.
- Alsea Geospatial will delineate 200 feet on either side of the stream centerline to create the first-level riparian/stream reach polygon map layer.
- Using aerial photographs from the City to break down riparian/stream reach polygons further by habitat component descriptors (see Habitat Component Descriptors in Table 1), the final polygon layer will be a Riparian Condition Units Map.
- Alsea Geospatial will produce a working map of map units for attributing.
- SHAPIRO will create a manuscript of map unit attributes and scoring ratings using a working map.
- Alsea Geospatial will incorporate the manuscript into a GIS layer as an associated .dbf file.

DETERMINATION OF RIPARIAN CONDITION

Schema

- Table 1 numeric values in parentheses are ranking scores of specified habitat component conditions.
- SHAPIRO will assume that industrial is worse than commercial, which is worse than residential, which is worse than undeveloped, because of the relative degree of impervious area and runoff pollutants.

- Actual tree size (dbh) cannot be interpreted from aerial photographs; therefore, relative categories will be interpreted instead.
- The map of impervious surface will be used to compare and confirm relative condition ratings.

Scoring

- The maximum possible sum is 13.
- The minimum possible sum is 0.
- Normalizing each score by dividing by 13 makes each rating category or condition modifier get equal weighting.
- The range of all possible scores after normalizing is 0.00-1.00.
- The ratings or RCU designations are as follows:

0.00-0.25 = fully functionally

0.26-0.50 = nearly fully functional

0.51-0.75 = partially function

0.76-1.00 = non-functional

Table 1: Riparian Condition Unit Determination Schema

Habitat Component Descriptors			Component Condition Modifier					
Stream Size <u>SS</u>	Vegetation Type <u>VT</u>	Tree Size <u>TS</u>	Land Use <u>LU</u>	Infrastructure Impingement <u>IMP</u>	In Channel Alteration <u>CA</u> *	LWD Recruitment Potential <u>LWD</u>	Shade Potential <u>SP</u>	Total of row score
<u>small</u>	conifer <u>con</u>	none <u>na</u>	<u>Undeveloped</u> (0)	<u>non-impinged</u> (0)	<u>unaltered</u> (0)	<u>high</u> (0)	<u>high</u> (0)	<u>0</u>
<u>medium</u>	hardwood <u>hw</u>	seed/sap <u>ss</u>	<u>Residential</u> (1)	<u>partially impinged</u> (1)	<u>moderately altered</u> (1)	<u>moderate</u> (1)	<u>moderate</u> (1)	<u>5</u>
<u>large</u>	mixed <u>mx</u>	pole <u>pol</u>	<u>Commercial</u> (2)	<u>fully impinged</u> (2)	<u>heavily altered</u> (2)	<u>low</u> (2)	<u>low</u> (2)	<u>10</u>
	brush <u>br</u>	medium <u>med</u>	<u>Industrial</u> (3)			<u>none</u> (3)	<u>none</u> (3)	<u>9</u>
	meadow/yard <u>m/y</u>	large <u>lg</u>						24
	pasture/ag field <u>pas/ag</u>							
	non-vegetated <u>nv</u>							
Total of Column Scores			6	3	3	6	6	24

* From channel habitat condition assessment module

Scoring Scenario Examples

- Example 1 (random):

residential = 1

partially impinged = 1

no in-channel alterations = 0

LWD = 1

shade = 2

total score = 5

normalize = $5/13 = 0.39$

- Example 2 (max):

industrial = 3

fully impinged = 2

heavy in-channel alterations = 2

LWD = 3

shade = 3

total score = 13

normalize = $13/13 = 1.00$

- Example 3 (min):

undeveloped = 0

non-impinged = 0

unaltered channel = 0

LWD = 0

shade = 0

total score = 0

normalize = $0/13 = 0.00$

DESCRIPTION OF RIPARIAN HABITAT CONDITION UNIT TERMS

Component Descriptors

Stream Size SS

- average active channel width
- small, ephemeral/intermittent/perennial
- medium, all perennial
- large, all perennial

Vegetation Type VT

- dominant tree species >70% of stand (conifer or hardwood)
- tree density: 0-5%, 5-20%, 20-50%, >50% (by ocular estimation)
- mixed species, 40/60, 60/40, 50/50 (by ocular estimation)

- brush/tree mix, trees comprise 5-20% of vegetative component, brush species comprise >80%
- brush, <5% trees
- meadow/yard
- pasture/agricultural field
- non-vegetated

Tree Size TS

NOTE: Tree size (dbh) cannot be interpreted from aerial photographs; therefore, relative categories are interpreted.

- none, trees comprise less than 2% of vegetative component
- seed/sap, immature small trees, pioneer stage, about 0-6 in dbh
- pole, immature small to medium size trees, early seral stage, about 6-16 in dbh
- medium, nearly mature, mid-seral stage, about 16-26 in dbh
- large, mature, late-seral stage, about >26 in dbh

Condition Modifiers

Land Use LU

- undeveloped (un)
- residential (res)
- commercial (com)
- industrial (ind)

Infrastructure Impingement IMP

- % of reach length impinged, twice the reach length equals the total bank length per reach
- non-impinged, no impinging structures or infrastructure on floodplain or streambanks
- partially impinged, impinging structures or infrastructure on floodplain or streambanks present, less than 60% of total bank length affected
- fully impinged, >60% of total bank length affected

In-Channel Alteration CA

- From channel habitat-typing element

Large Woody Debris Recruitment Potential LWD

- none, no trees, all seed/sap, all poles, <2% of vegetative component is trees
- low, <2% of trees are medium or large
- moderate 2-50% are trees of medium to large stature
- high >50% large trees

Shade Potential SP

- none, <2% of vegetative component provides some shade during any part of the day
- low, 5-20% of vegetative component provides some shade during any part of the day
- moderate, 20-50% of vegetative component provides some shade during any part of the day
- high, >50% of vegetative component provides some shade during any part of the day

Overall Condition Rating

- Model final rating toward NMFS ratings; for example, functional, non-functional, or at risk, and so on
- fully functional
- at risk
- non-functional

Detailed riparian analyses will consist of a ground-truthing of data provided from aerial photograph interpretation and GIS layers. Specific protocols will follow those established in the “Urban Riparian Inventory and Assessment Guide” published by the Oregon Division of State lands. More detailed information on tree sizes will be obtained in this process.

